

# Using variables

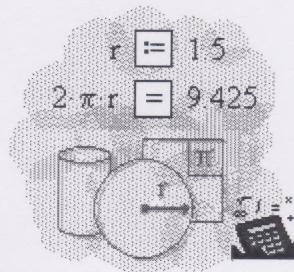
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## Introduction

In this document you will learn how to create and use variables.

Their use in expressions and calculations is crucial to the successful application of Mathcad.

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Before you can create a variable you need to know about the palette.

The **palette** is the strip of **icons** running down the left-hand edge of the Mathcad window.

Here is a picture of the first few icons, with one of them highlighted.

## Task

### ► Type **3.6\*2.9**

then click on the ( real )  icon in the palette to see the answer.



Click elsewhere on the page or press the [.] key to finish.

You should obtain the answer **10.44** ; if not, scroll down to see the **help** at the bottom of this page.

- The  icon stands for **Evaluate expression**.

In Mathcad there are always at least two ways of doing anything !

You saw in file 121A0-03 that you can type the equals key = for the same effect, i.e. enter the keystroke sequence **3.6\*2.9=**

- There are five palettes in all.

To reveal the other palettes, click on the button at the top of the palette, e.g. 

Clicking on button 1 displays palette 2 ; clicking on 2 displays palette 3, and so on. Clicking on the final button 5 will take you back to the first palette.

The first three palettes are used to insert a variety of mathematical operators, whilst palettes 4 and 5 contain Greek letters for use within expressions and text.

## Help

- The diagram below shows what you should see before and after you click on the icon.

3.6·2.9  3.6·2.9 = 10.44

Note the position of the blue bar cursor. You click on the icon immediately after typing the 9.

If you make a mistake, or anything goes wrong, just delete the entire expression and start again.

- Make sure that you click on the real icon in the palette strip, at the left-hand edge of the window.

The icons shown within the document, like this  , are just pictures.

Nothing happens if you click on them !



A **variable** is a quantity which can vary ; it is represented by a symbol ( the variable name ).

The **Assign value to variable** palette icon is used to **define** a variable.

Variables greatly enhance what you can do in Mathcad. By defining them you can link equations together and store intermediate results for use in further calculations.

For example -

Define the variable **x** to have value **2.5** by  $x := 2.5$

Display the values of **x**, **4x** and  **$x^2$**  .....  $x = 2.5$   $4 \cdot x = 10$   $x^2 = 6.25$

( If **x** denotes the length of the side of a square,  
then the values of  $4x$  and  $x^2$  give the perimeter and the area of the square. )

## Task

► Let's define another variable, called **r**, to have value **1.5** .

Type **r** then click and continue typing **1.5**



Click elsewhere on the page or press the **[.]** key to finish.

This is what you should see, as you type and click. If not, delete your expression and try again.

$\text{r} \rightarrow \text{:=} \rightarrow \text{r} := \text{1.5} \rightarrow \text{r} := 1.5 \rightarrow \text{r} := 1.5$

► Once a variable **r** has been defined, you can evaluate any expression involving it.

To check this, first display the value of **r**. Type **r**

then either type **=** or click



This is what you should see -  $\text{r} \rightarrow \text{=} \rightarrow \text{r} = 1.5$  .

If you are using the palette, make sure that you click on the correct icon.

Don't forget to click elsewhere on the page or press the **[.]** key to finish.

► Then you may like to try something more complex.

For example, if **r** denotes the radius of a circle then you can display the circumference of the circle,  $2\pi r$  . ( The mathematical constant  $\pi$  is built into Mathcad and can be obtained by clicking on the appropriate icon on palette 1. )

Type **2\*** then click , continue typing **\*r**  
then either type **=** or click



When **r** is 1.5 the value of  $2\pi r$  is 9.425 - this is what you should see as you type and click.

$2 \rightarrow \pi \rightarrow 2 \cdot \pi \rightarrow 2 \cdot \pi \cdot \text{r} \rightarrow 2 \cdot \pi \cdot 1.5 \rightarrow \text{=} \rightarrow 2 \cdot \pi \cdot 1.5 = 9.425$  .

( You must include all the multiplication signs when entering formulas in Mathcad. )

Read through these instructions then try the task below.

■ To alter the value assigned to a variable you simply **edit** the right-hand side of the **definition**.

Start by clicking on the right-hand side of the definition.

If you get a blue box, keep pressing 'Down Arrow' [↓] until the blue bar cursor | appears.

Then use the left and right arrow keys to position the cursor as required (1).

Rub out with the [Backspace] key (2), as required, and enter the new value (3).

Click elsewhere on the page or press the [J] key to complete the edit (4).

1  $r := 1.5$     2  $r := 1|$     →  $r := 1$     3  $r := 2$     4  $r := 2$

### Task

► Edit the definition for  $r$  below to find the circumference for a circle of radius 2, then 5.

( Watch what happens to the expressions displayed on the right as you edit the definition. )

Define the radius of a circle



$r := 1.5$

Display the radius ....  $r = 1.5$

and the circumference  $2\pi r = 9.425$

Each expression involving the variable is updated automatically, using the new value.

When  $r$  is 2 the value of the circumference  $2\pi r$  is **12.566**, and when  $r$  is 5 it is **31.416**.

( Note that all the values in this document are displayed to three decimal places. )

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When working with variables ( and Mathcad in general ) you often have the choice of a mouse / click way or a keyboard way of doing things.

You have already seen that clicking on the  icon and typing `=` have the same effect.

In fact Mathcad provides keyboard alternatives for all the palette icons.

Icon	Key
Define variable 	: Colon - given by [Shift];
pi ..... 	<b>[Ctrl]p</b> Hold down the control key, [Ctrl], and type p

There is the opportunity to try out these keyboard alternatives in the task below.

Whether you click on the palette icons, type the keyboard alternatives or use a combination of the two, the end result is the same in Mathcad, so use the method which suits you best.

## Task

Find the area of the base **A** and the volume **V** of a cylinder of height **h** ( $= 8$ ) whose ends are circles of radius **r** ( $= 1.5$ ).

The variables **r** and **h** are defined for you.

Definition for the radius **r** of the circular base  $r := 1.5$

Definition for the height **h** of the cylinder .....  $h := 8$

Enter the expressions below, first to define **A** and **V**, and then to display them.

( If you get stuck, **help** is provided at the bottom of this page. )

► Define a variable **A** to be the area of the base.

Type **A** then click  ; click  then type `*r^2`   
( Alternatively just type **A:[Ctrl]p\*r^2** )

► Define a variable **V** to be the volume of the cylinder, that is **A** times **h**.

► Now display  
the value of the area **A**  and volume **V** 

► Compare your answers with the solution given on the next page.

### Help with entering the expressions

► To define the variable **V** you could either - type **V** then click  ; then type **A\*h**  
or - just type **V:=A\*h**

Either way, you must include the multiplication sign between the **A** and the **h**.

► To display the value of **A** or **V**, simply type the variable name then either type `=` or click 

■ This is our solution.

Definition for the radius  $r$  of the circular base  $r := 1.5$

Definition for the height  $h$  of the cylinder .....  $h := 8$

Define a variable  $A$  to be the area of the base.  $A := \pi \cdot r^2$

Define a variable  $V$  to be the volume of the cylinder, that is  $A$  times  $h$ .  $V := A \cdot h$

Display the value of the area  $A$   $A = 7.069$  and volume  $V$   $V = 56.549$

So for a cylinder of height 8 and base radius 1.5 the area of the circular base is **7.069** and the volume is **56.549**. ( Note that both these values are given to three decimal places. )

■ Note that Mathcad processes the information in a document the same way as you read it : from left to right and top to bottom, going down the screen line by line. This order is important as variables must be defined above the place in the document where they are first used. ( On the same line and to the left counts as above, but to the right counts as below. ) In this task the variable  $r$  must be defined before it can be used in the definition for the variable  $A$ . Likewise, both  $A$  and  $h$  must be defined before they can be used in the definition for  $V$ , and  $A$  and  $V$  must have been defined before you can display them.

■ If you try to use a variable before it has been defined, Mathcad highlights it and displays the message 'Undefined variables shown in reverse' in the status bar at the bottom of the Mathcad window. The picture on the right shows examples of two undefined variables,  $V$  and  $a$ .

$V =$   
 $V := a \cdot h$

Likely causes of this problem are trying to define a variable using  $=$  instead of  $:=$  or simply a typing mistake, entering the wrong variable name. Note that variable names are case specific :  $A$  and  $a$  are two different variables in Mathcad.

#### ► A final optional task

Use your formulas on page 5 to confirm that the volume of a baked bean tin is **464.491 cm<sup>3</sup>**. ( The radius of the base is 3.7 cm and the height of the tin is 10.8 cm. )

END